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ENHANCED POWER WITHIN A SPECIFIC BAND OF THETA ACTIVITY IN ONE PERSON WHILE ANOTHER RECEIVES CIRCUMCEREBRAL PULSED MAGNETIC FIELDS: A MECHANISM FOR COGNITIVE INFLUENCE AT A DISTANCE?[1]

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Summary.—Four pairs of adult siblings served once as either the stimulus or the response person in two sessions separated by one week. While the brain of the stimulus person, who was seated in a closed chamber, was exposed successively to six different complex magnetic fields for 5 min. each quantitative monopolar electroencephalographic measurements over the frontal, temporal, parietal, and occipital lobes were collected by computer for the response person who was seated in another room. The six configurations of fields served as different stimulus patterns and had been designed to affect consciousness. As predicted theoretically, a significant increase in electroencephalographic power within the 5.0-Hz to 6.0-Hz band over the frontal and occipital lobes was noted for the response persons when the stimulus persons received one of the six specific patterns of weak (1 microTesla range) magnetic fields. This magnetic stimulus was presented for 100 msec. with changes in rate of 20 msec. to each of the eight solenoids that were equally spaced in the horizontal plane around the head of the stimulus person. Derivatives within this narrow frequency band had been hypothesized to be a source of the "binding factor" for the cohesive cerebrogenic electromagnetic fields producing consciousness. The results suggest that an appropriate altered state of one brain can effect specific predictable frequencies of the electroencephalographic activity of another distant brain which is genetically related.

Consciousness has been argued to be evident in the emergent, cohesive electromagnetic patterns (Edelman, 1989) generated by the synchronous firing of large numbers of neurons within the human brain (McFadden, 2002). Llinas and Pare (1991) and Llinas and Ribary (1993) have shown that transcerebral electromagnetic waves of intracortical activity move in a frontal to occipital direction. They measured phase-shifts and repetitions between 15 and 25 msec. These neuroelectromagnetic configurations occurred specifically in the states of consciousness popularly labelled waking and dreaming.

If consciousness is created by the specific timing of complex electromagnetic fields generated within brain space as suggested by Edelman (1989), then application of the appropriate geometries and temporal patterns of weak magnetic fields should interact with the endogenous patterns. The mechanism of interaction would not require a linear induction of electric

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current. Instead, the process should involve the entanglement and disentanglement of the complex flux lines generated by the cerebrogenic fields and by the applied experimental fields. This mechanism would be similar to the interaction between the geomagnetic field as it extends several earth radii into deep space and the "applied" interplanetary magnetic fields produced by the sun. Interactions at the magnetopause can be propagated through hundreds of kilometers to below the earth's surface.

Cook, Koren, and Persinger (1999) reported that the application of pulsed magnetic fields in a counterclockwise direction within the horizontal plane around a person's head resulted in subjective time distortion. This alteration was most evident when the rate of change in the presentation of the field to each of the eight solenoids that successively generated the circumcerebral magnetic fields was about 20 msec. This value for the derivative has also been associated with the increased accuracy for one person reporting the shared "memories" of a second person who was viewing randomly selected pictures in another room (Persinger, Cook, & Tiller, 2002).

The possibility of a representation in one object when a second object, separated in space, is stimulated has been described as nonlocality in quantum physics (Cramer, 1997; Radin, 1997). At macroscopic levels, stimulation with very minute energies of one of two Tesla coils with very similar spatial and conductive geometries can induce a signal in the second coil at significant distances. Other more metaphysical models, such as the morphometric fields described by Sheldrake (1981), suggest that two separate circumscribed spaces with very dense and very similar internal structures, often labelled as objects, can interact at infinite distances because of their identical complexity (Persinger, 1999b).

To design the present study, it was reasoned that two human brains can be conceived of as two circumscribed spaces within which a high density of both spatial structure and very similar temporal patterns of electromagnetic fields are produced. If two human brains could be considered to be like two separate Tesla coils, then the stimulation of one brain by the appropriate electromagnetic stimulus should evoke electromagnetic patterns within the other brain at a significant distance. The present study was designed to test the validity of this concept.

The design was simple. For each experiment six different temporal configurations of complex magnetic fields that have been shown to affect subjective time and facilitate phenomena attributed to paranormal processes were applied for 5 min. each (total time 30 min.) around one person's head. They were defined as stimulus patterns. While this person was sitting in an acoustic chamber which was also a Faraday Cage, another person was sitting in another room, blindfolded and wearing ear plugs, while quantitative electroencephalographic measurements were collected by computer.

If the hypothesized model were correct, then the application of circumcerebral magnetic fields with 20-msec. rates of change (rather than 20-msec. fixed durations) around one brain should enhance the power within the 5- to 6-Hz band of theta activity but not the power of other frequency bands of another brain. The increment of 5 Hz to 6 Hz has been hypothesized (Persinger, 1999a) to mediate one aspect of consciousness. If the critical parameter was the derivative, then the effect would be present with different shapes of pulses delivered by this derivative. We employed our traditional two-pulse patterns labelled as frequency-modulated and burst-firing, which exhibit increasing or decreasing interpulse intervals, respectively (see Persinger, 2003, for figures).

Method

Subjects

Four pairs of siblings (three brother-sister; one sister-sister) served as subjects. One of the siblings from each pair was enrolled in a first-year psychology course. The ages of the subjects ranged between 20 and 24 years ($M = 20.5$, $SD = 1.1$). The subjects enrolled in the course received a 2% bonus mark for participation. The other subjects were asked by their siblings to participate.

Procedure

On eight separate days, a single pair of siblings was tested. For one experiment, one sibling (the stimulus person) was exposed to the circumcerebral magnetic fields while the other sibling's (response person's) electroencephalographic activity was recorded. After a minimum of one week had elapsed, the pair returned to the laboratory at which time the sibling whose electroencephalographic activity had been taken the previous week received the same six temporal patterns of magnetic stimuli, except these were presented in the reversed order, while the other sibling's electroencephalographic activity was measured.

For all experiments, the two subjects were first shown the acoustic chamber in which one would sit and the arm chair in an adjacent room in which the other sibling would sit during the experiment. Eight solenoids attached to a Velcro strap were placed around the head of the stimulus person just above the ears. This person received the circumcerebral magnetic fields by a device called "The Octopus." It has been described previously (Cook, *et al.*, 1999). The details can be found in U.S. Patent Number 6,312,376 (6 November, 2001). This procedure was performed by M. A. Persinger. At the same time, E. W. Tsang attached silver electrodes by EC2 electrode cream to the scalp over the left and right prefrontal (F7, F8), temporal (T3, T4), parietal (P3, P4), and occipital (O1, O2) lobes of the response person. Both procedures required about 10 min.

Both subjects sat in comfortable arm chairs which faced south according to the direct measurements of declination by a magnetometer. Both subjects were blindfolded. The response person, whose quantitative EEG was recorded, was fit with disposable earplugs while the subject who received the magnetic fields was housed in a closed acoustic chamber. The strength of the resultant geomagnetic field within the sitting area within the closed chamber was measured by a MEDA FM-300 magnetometer to be between 20,775 to 20,790 nT, with a fixed inclination of 71.5°. For comparison the resultant geomagnetic field strength at head level within the chair in which the response person sat was between 48,950 nT and 49,005 nT, with a fixed inclination of 61.1°.

With the Octopus placed around the stimulus person's head in the chamber and the equipment activated, except no fields were initiated, the resultant strengths did not change. The strengths for the X, Y, and Z components were 6,617 nT, 245 nT, and 19,721 nT, respectively. When the circumcerebral fields were operating, the peak-to-peak changes in the static field within the center of the circumference around which the eight solenoids were attached ranged between 100 and 250 nT. According to a Metex N380 power meter, the maximum strength of the higher frequencies was 1.5 microT within 1 cm (inward) from the perimeter and a more homogeneous 500 nT at the center. The field strengths in the center perpendicular to the plane along which the solenoids were arranged varied between 200 and 800 nT. When the circumcerebral fields were not operating, the background values were below 20 nT.

Before the experiment began, the stimulus person, to whom the fields were delivered, was told to imagine being in the other room with the brother or sister and to imagine touching that sibling. There were two reasons for this instruction. First, directed imagination, expressed as prayer, mantras, or vivid imagery, has been implicated in claims of distal healing as well as out-of-body experiences. Second, directed imagination was assumed to decrease the individual variability (and hence, "error variance") of the types of thinking displayed while sitting blindfolded and alone in a quiet chamber After verification that the magnetic field equipment was functioning by direct measurement of the presence of the fields around the stimulus person and the electroencephalographic measurements were determined to be artifact free from the response person, the experiment began.

Each stimulus person received the same six separate patterns of 5 min. each that had been employed in other studies (Richards, Koren, & Persinger, 2002), in a counterclockwise direction around the head. We employed only the counterclockwise direction because in previous studies it had been shown to evoke the greatest effect on subjective time experience (Cook, *et al.*, 1999) and electroencephalographic activity (Richards, *et al.*, 2002). The

specific parameters for these six patterns are shown again in Table 1. Half of the stimulus persons received the six patterns in the order from left to right; the other half of the stimulus persons received the six patterns in the reverse order. The activation of each pattern was controlled by a single batch file so once the experiment had begun there was no further requirement to program the computer controlling the experiment.

TABLE 1
FIELD PARAMETERS EMPLOYED DURING APPLICATION OF COUNTERCLOCKWISE CIRCUMCEREBRAL MAGNETIC FIELDS

Pulse Type	Burst-firing Frequency-modulated					
Phase	1	2	3	1	2	3
Point Duration	1	1	3	1	1	3
Interstimulus Interval	1	1	3000	1	1	3000
Duration of Field	20	100	200	20	100	200
Change Duration of Field	+2	+20	−2	−2	+20	−2

During the experiment, the response person's electroencephalographic activity was continuously recorded on paper by a Grass Instruments Model 8-16C machine. The filter selections for each channel were set for the standard range between 0.5 Hz and 35 Hz. At exactly 2.5 min. after the initiation of each (5 min.) pattern, the first experimenter walked to the door of the adjacent room in which the response person (blindfolded with earplugs) was sitting and placed a sheet of paper on the table beside the computer connected to the electroencephalograph. The paper contained a number between 1 and 6 that the third experimenter, sitting beside the EEG, employed as a code for identifying the digital sample of the ongoing electroencephalographic activity of the response person. The EEG machine was about 2 m from the chair in which the response person was sitting. At closer distances the magnetic anomalies generated by the metal and constituents of the equipment enhanced the local static field substantially.

At this time, a 20-sec. sample of quantitative electroencephalographic activity was completed simultaneously from all eight leads. This Model 8-16C machine was interfaced via a custom shielded cable, a parallel-analogue shielded interface cable (National Instruments SH100100), and a shielded connector block (National Instruments SCB-100) to a National Instruments PCI-607IE Multi I/O Board computer interface card. The data collection was extracted by a DELL Dimension 8100 Personal Computer on a Windows 200 Professional Platform. A custom-designed user interface or Virtual Instrument (VI) using National Instruments Labview (Version 6.0i-2000) allowed the multichannel sample to be manually recorded to fixed disk.

At the end of the experiment, the equipment was removed from the two subjects. Each completed an exit questionnaire which contained items

requesting the incidence of common experiences reported during these episodes. The hard copies of the electroencephalographic records were shown to both subjects. The general characteristics and implications of the records were described by the first author (MAP) for the benefit of the subjects.

When all of the data had been collected for the experiment, the digital electroencephalographic recordings were analyzed by the second author (SAK) with a custom programmed software package for Fast Fourier Transforms. The software was compiled under Borland Pascal (Version 5.5, 1986). The Fast Fourier Transform utilized three publicly available Pascal software libraries for standard mathematical functions that included the FMATH, FOURIER, and MATRICES sections from the IPMath 1998-2001 math library by Jean Debord (http://www.unilim.fr/pages_perso/jean.debord/tpmath/tpmath.htm).

The frequency spectral outputs from each lead from the four lobes of the two hemispheres for the six patterns were extracted into a single file for 1-Hz increments between 3.0 Hz to 3.9 Hz, 4.0 Hz to 4.9 Hz, 5.0 Hz to 5.9 Hz, 6.0 Hz to 6.9 Hz, 7.0 Hz to 7.9 Hz, and 8.0 Hz to 8.9 Hz. The file was created to test the specific hypothesis that any effect would occur within a narrow band of about 1 Hz between 5 Hz and 6 Hz (Persinger, 1999a). This file was then uploaded to a VAX System for analyses.

Before the experiment, the values from the quantitative analyses of the electroencephalographic data had been assured to be valid by counting by hand the numbers of seconds during the 20 sec. of extraction that contained alpha rhythms and correlating these values with the numerical values for power within the alpha range for a single subject. The subject had been asked to open her eyes four times and close her eyes three times for 20 sec. each just before the quantitative recordings began. The Pearson correlation between the percentages of 1-sec. increments of alpha rhythms per 20-sec. sampling (range 10% to 100%) and the actual power values (range 3 to 13 microV) was .93. The Spearman *rho* value was .97 ($df=7$).

To accommodate individual differences, the means of the raw data for the measurements during the presentation of the six different magnetic field patterns to the stimulus person were calculated for each of the frequency increments for the electroencephalographic power recorded from the brains of the response person. The standard deviations for these six values were also calculated. z scores were computed with SPSS software for the standardized power values of the response person's digital electroencephalographic data when the stimulus person was being exposed to each of the six magnetic patterns. These values were calculated for each of the six 1-Hz frequency bands separately.

The primary experimental design for the statistical analysis was a five-way analysis of variance with four within-subject factors and one between-

subject factor. The within-subject factors were the four lobes, the two hemispheres, the types of pulse (burst-firing vs frequency-modulated) and the types of phase (the different configurations of time constants for both types of pulses). The between-subject factor was whether the subject had served as the stimulus person (exposed to the magnetic fields) or the response person (quantitative electroencephalographic activity had been recorded) either during the first or second week.

These five-way analyses of variance were completed separately for each of the six 1-Hz frequency bands. The simultaneous inclusion of all six frequency bands within the analyses was prevented by the limitations of SSPS software. All analyses involved a VAX computer. *Post hoc* analysis involved correlated t tests, as well as combinations of correlated t tests and Tukey tests ($p < .05$) for interactions between independent and within-subject factors. Because F and probability values do not reliably indicate how much variance was explained, it was decided to report the effect-sizes as defined by eta-squared values. F values significant at $p < .05$ and $p < .01$ are marked.

In light of the relatively unique electroencephalographic activity of Ingo Swann who displayed enhanced power within a narrow band around 7 Hz, the source of the interactions for the 6.0- to 6.9-Hz and 7.0- to 7.9-Hz bands were also examined. During "remote viewing," Mr. Swann had generated persistent 7-Hz spikes that would have been reflected as increased power within the 6.0- to 6.9-Hz or 7.0- to 7.9-Hz sampling in this study. The proportions of this 7-Hz paroxysmal activity over Mr. Swann's occipital lobes were correlated with his accuracy of describing hidden objects at a distance (Persinger, Roll, Tiller, Koren, & Cook, 2002).

Results

The eta-squared values, in terms of percentage of explained variance, for the results of the five-way analyses of variance for each of the six 1-Hz frequency bands are shown in Table 2. We first examined the empirical support for the primary hypothesis. It was that there will be an enhancement of power within the 5-Hz to 6-Hz band of the electroencephalographic record of the response person when the brain of the stimulus person was exposed to the magnetic field configuration with a rate of circumcerebral change of 20 msec.

The only statistically significant effect within the 5.0-Hz to 5.9-Hz increment was a statistically ($p < .01$) significant interaction between lobe, pulse (frequency-modulated versus burst-firing), and phase (rates of change). The results of the *post hoc* (correlated t tests) analysis are shown in Fig. 1. The primary source of the interaction was the increase in relative power, equivalent to more than 1 *SD* (z score), within both frontal lobes and both occipital lobes of the response persons while the stimulus persons' brains were be-

TABLE 2

ETA-SQUARED VALUES (%) OR EFFECT SIZES OF VARIOUS FACTORS FOR SIX 1-HZ BANDS OF STANDARDIZED MEASUREMENTS OF ELECTROENCEPHALOGRAPHIC POWER FOR EIGHT SUBJECTS

Variable	3.0–3.9	4.0–4.9	5.0–5.9	6.0–6.9	7.0–7.9	8.0–8.9
Pulse	03	05	00	04	00	03
FS × Pulse	42	39	47	23	34	16
Phase	12	10	11	10	43*	08
FS × Phase	00	13	16	16	33	01
Lobe × Pulse	10	03	02	08	02	06
FS × Lobe × Pulse	14	03	09	05	23	06
Lobe × Phase	13	18	22	18	22	14
FS × Lobe × Phase	08	05	17	18	31*	13
Hemisphere × Pulse	04	11	00	09	10	14
FS × Hemisphere × Pulse	21	02	29	14	24	30
Hemisphere × Phase	06	48*	08	11	12	07
FS × Hemisphere × Phase	05	44*	06	04	17	07
Pulse × Phase	11	02	17	28	26	55†
FS × Pulse × Phase	06	03	20	19	10	20
Lobe × Hemisphere × Pulse	25	18	23	22	09	06
FS × Lobe × Hemisphere × Pulse	37*	06	25	11	03	16
Lobe × Hemisphere × Phase	14	19	09	21	17	05
FS × Lobe × Hemisphere × Phase	18	16	21	30*	06	20
Lobe × Pulse × Phase	23	04	37†	20	27*	18
FS × Lobe × Pulse × Phase	21	09	24	07	09	14
Hemisphere × Pulse × Phase	08	09	10	28	24	08
FS × Hemisphere × Pulse × Phase	18	17	02	04	04	13
Lobe × Hemisphere × Pulse × Phase	19	10	23	10	25	23
FS × Lobe × Hemisphere × Pulse × Phase	12	17	14	07	13	08

Note.—FS = Field first or second week. *$p < .05$. †$p < .01$.

ing stimulated by the burst-firing pattern when the derivative, or the change in the successive time the field remained activated at each solenoid, was 20 msec. Statistically speaking, this result was considered partial support for the primary hypothesis because the effect occurred only for the burst-firing but not the frequency-modulated pattern.

Statistically significant interactions were found between phase and pulse for the two adjacent 1-Hz frequency bands (6.0 Hz to 7.9 Hz) associated with Ingo Swann's accuracy of remote viewing. The results of the *post hoc* analysis for the significant interaction between test order (magnetic field first or EEG first) lobe and phase are shown in Table 3. One component of the source of the interaction was the relatively greater power within the occipital lobes of the response person when the magnetic pulses were being delivered for 20 msec. with 2-msec. rates of change to the stimulus person only if the response person had first been exposed to the field during the previous week. The other component was the decrease in power over the frontal lobes within the 7.0-Hz to 7.9-Hz band when subjects who were exposed first to the 100-msec. fields with 20-msec. rates of change were tested 1 wk. later.

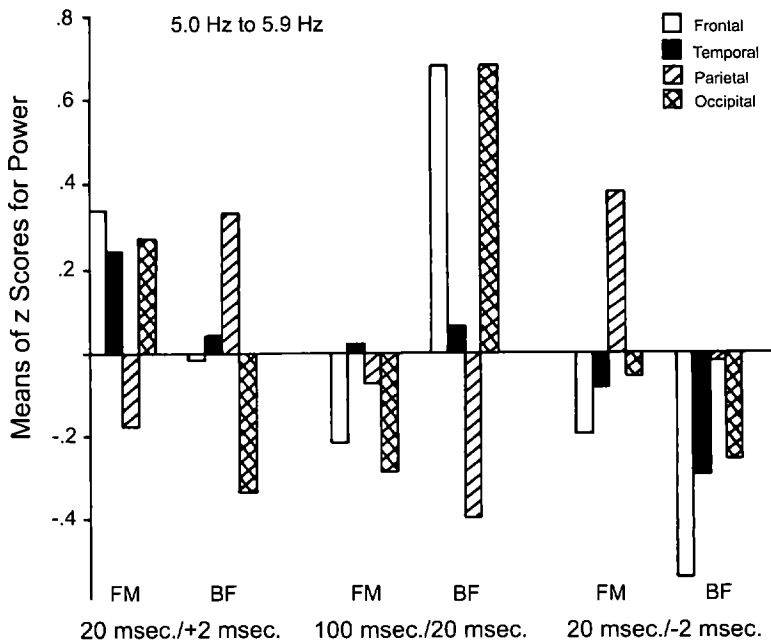

FIG. 1. Means of the z scores for power within the 5.0-Hz to 5.9-Hz band over the frontal, temporal, parietal, and occipital lobes of the response persons when the stimulus persons' brains were exposed to various parameters of frequency-modulated (FM) and burst-firing (BF) patterns.

The only statistically significant interaction within the 6.0-Hz to 6.9-Hz band was carefully examined. The results of the *post hoc* analyses for the interaction between hemisphere, lobe, phase, and whether the person's electroencephalographic activity had been measured before or after the exposure to the circumcerebral magnetic fields reiterated the enhanced power within the left ($z = .77$) and right ($z = .78$) frontal lobes when the stimulus person was being exposed to the 100-msec. fields with derivatives of 20 msec. There was a significant discrepancy between the power over the left occipital lobe ($z = .65$) compared to the right occipital lobe ($z = -.73$).

This enhancement of power over both frontal lobes and the left occipital lobe but marked decrease of power over the right occipital lobe was not measured over the brains of people who had received the fields the previous week. Except for enhancement of power over the left parietal region ($z = .50$) and the right temporal region ($z = .40$) during the presentation of fields with 20-msec. durations at each solenoid and accelerations of 2 msec. around the brains of the stimulus persons, the z values for all measurements ranged between $-.22$ and .25 with standard errors of the mean of .2 and .3.

TABLE 3
MEANS OF z SCORES FOR POWER WITHIN THE 7.0-HZ TO 7.9-HZ BAND OVER FRONTAL, TEMPORAL, PARIETAL, AND OCCIPITAL LOBES DURING PHASES 1, 2, OR 3*

Lobe	EEG First–Field Second			Field First–EEG Second		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Frontal	−.37	.69[c]	−.36	.34	−.22[d]	−.36
Temporal	.45	−.21	−.36	.32	−.06	−.25
Parietal	.23	−.18	−.17	.47	−.17	−.10
Occipital	−.30[a]	.47	−.22	.75[b]	−.04	−.45

*(See Table 1) For subjects whose electroencephalographic activity was measured first or who were exposed to the field first and whose EEG was recorded during the second week. Standard errors of the mean ranged between .2 and .4. [a vs b, c vs d] $p < .05$.

DISCUSSION

The results of this experiment support the concept that stimulation of one of two spaces with very similar microstructure and electromagnetic properties is accompanied by changes within the second space. The most common example of this phenomenon is the induction of current within a matched (open circuit) second electromagnetic coil whose geometric structure and electrical properties are identical to the coil in which a signal had been generated. It was reasoned that two brains, even separated by substantial functional distances, could be described as two Tesla coils.

The second physical principle assumed to operate is resonance. It occurs across all levels of scientific discourse (Persinger, 1999b) when the temporal characteristics of an applied force can be represented within the intrinsic structure of the mass to which the force is applied. When this congruence occurs, less energy is required to elicit a response within the matter or a greater response is elicited by an intensity of the force that would yield negligible changes if applied with any other temporal parameters.

For the human brain we predicted that the optimal electromagnetic pattern to induce resonance within the brain of the stimulus person would require some variation of a duration or a rate of duration of about 20 msec. This interval is the range of values reported by Llinas and Pare (1991) and Llinas and Ribary (1993) of the phase shift in the cohesive wave of electromagnetic energy that propagates between the rostral and caudal portions of the brain. Stated alternatively, the electromagnetic candidate for the "binding factor" for the cerebral cortical activity producing consciousness (McFadden, 2002) may be recreated approximately every 20 msec. A similar estimate for the re-entrant processes, another description of the rate of change or derivative, has been suggested by Edelman (1989). Although no clear neuroelectrical substrates have been clearly shown for the "binding factor," it is assumed to exist as a unified process within most or all of the manifold of the cerebral cortex. From a neuroelectromagnetic perspective, this distinctive

collective behavior and variety of wave modes that enable effective energy transfer between ions and wave fields *are* consciousness and awareness.

We predicted that the application of a natural, resonant frequency to one (the stimulus) brain would, like two Tesla coils, produce an amplification of the power within the brain of the response person even though the person was separated by substantial distance involving several structural boundaries. In this instance the stimulus person was housed within a double-walled, sealed steel acoustic chamber contained in a separate room from the one in which the response person was sitting.

Although peak-to-peak changes every 20 msec. translates into a frequency of about 50 Hz (Jeffreys, Traub, & Whittington, 1996), Persinger (1999a) had predicted that the actual recreations of the 20 msec. would occur within the "derivatives" or phase-shifts in frequencies within the 5-Hz to 6-Hz band. Lagged differences in real time between integers representative of adjacent frequencies indicated clustering of approximately 20-msec. intervals when differences between first-order and second-order subtractions were calculated. Persinger (1999a) suggested that substrates for consciousness might be nested in very narrow bands of frequency shifts or phase shifts that occur within a fraction of 1 Hz. The range of 5 to 7 Hz is also consistent with the equations of electromagnetic resonance applied by Nunez (1995) to the volume of the human cerebrum.

According to Niedermeyer and Lopes da Silva (1987), the mean frequency for intraindividual and interindividual frequencies for the alpha rhythm, as an example, is 10.2 Hz, with a range between 9.2 Hz and 11.1 Hz. This value of ± 0.9/sec. (about 1 Hz), around the average of normal distribution of frequencies, would mean 95% of the variations in the phase shifts or frequency modulations would occur within a 1-Hz range. Sixty-eight percent of the time the variations would be between 9.8 Hz and 10.8 Hz and would be difficult to discriminate during casual reading of hard copy records. Consequently, the existence of processes carried by the derivative of change in frequencies or phases of about 1 Hz within the 5 Hz to 6 Hz band could be conspicuous quantitatively but not assessed by the traditional methods employed to measure brain activity.

If the present model of interacting Tesla coils is correct, then the application around the brain of the stimulus person of a complex electromagnetic field whose temporal characteristics are resonant with the intrinsic, cohesive electromagnetic field generated by the brain should be reflected in a change in the electromagnetic field of the brain of the response person. The measurement of enhanced power within the 5-Hz to 6-Hz band of the brain of the response person would support the hypothesis that application of a rotating magnetic field with 20-msec. changes in time was resonant with the binding factor within the brain of the stimulus person.

However, the increase in power within the 5-Hz to 6-Hz band occurred as an interaction between lobe, pulse, and phase. The *post hoc* analysis indicated that the increase in power occurred only over the frontal and occipital lobes and not the entire brain. Llinas and Pare (1991) and Llinas and Ribary (1993) measured recursive phase shifts every 20 msec. in the cohesive fields that were generated between the frontal and occipital regions. If a rostral-caudal dipole exists from which this continuous stream of 20-msec. quanta of transcerebral waves are generated, then one might expect the maximum influence from resonance upon this process to occur within the sources of the dipole. Because there was no statistically significant interaction with which the person who served as the stimulus person first or second and the order of the six patterns was reversed in half of the subjects in a full factorial design, the likelihood that the specific effect of the burst-firing pattern presented for 100 msec. at the first solenoid but then increased by an additional 20 msec. at each successive solenoid was due to a confounding effect from serial presentation is minimal.

It may be relevant that Nowak and Marczynski (1981) observed 5-Hz to 6-Hz theta responses originating from either occipital lobe when some healthy volunteers were in a state of maximal alertness. Niedermeyer and Lopes da Silva (1987) indicated that occurrence of this band over the frontal midline has been associated with enhanced memory functions and concentration. The prevalence of increased power within the 5-Hz to 6-Hz band of normal young children during drowsy states (Niedermeyer & Lopes da Silva, 1987) would suggest children could be more vulnerable to the effects of the experimental procedure employed in the present study.

The only statistically significant main effect or interaction within the 6.0-Hz to 6.9-Hz band and 7.0-Hz to 7.9-Hz band involved an interaction between the order of the exposure of siblings (that is whether or not they were exposed to the magnetic stimulation during the first week or the second week) and the within-subject patterns of electroencephalographic activity. These bands were examined specifically because they were within the range of the conspicuous 7-Hz spikes displayed by Ingo Swann (Persinger, Roll, Tiller, Koren, & Cook, 2002) when he was actively attempting to discern the content of hidden photographs in another room. The duration of this electroencephalographic activity per trial was correlated significantly with the accuracy of his descriptions of the photographs as assessed later by blind ratings.

In the present study subjects who served as the response person first showed enhanced power over the frontal and occipital lobes within these bands when presented with either the burst-firing or frequency-modulated pulse if they were presented for 100 msec. with a change in rate of 20 msec. This was similar to the pattern within the 5.0-Hz to 5.9-Hz band. If the people had not been exposed to the fields first, they responded with in-

creased power over the frontal lobes when their siblings were receiving the fields presented 100 msec. at every solenoid with a rage of change of 20 msec. However, if the subjects had been exposed to the magnetic patterns the previous week and then returned to serve as the response person, the most significant increase in power within the 7.0-Hz to 7.9-Hz band occurred within the occipital region.

These results suggest that some process related to learning might have occurred. At this time one cannot differentiate if this learning was due to habituation to the actual electromagnetic pattern (because they had been exposed to it the previous week) or a different reaction to sitting in the response room after sitting in the stimulus room. The conspicuous increase in power within the occipital region when the subjects who had been stimulus persons were now serving as response persons would be consistent with Mr. Swann's contention that people can learn to respond to paranormal stimuli. The marked attenuation in or extinction of responses as a function of exposure to the putative stimulus effectively defines parapsychological research.

The differential enhancement of power over the occipital lobes within the 7.0- to 7.9-Hz range due to a history of exposure to an altered state of consciousness (in this case induced by the circumcerebral magnetic fields) would also be consistent with Persinger, Roll, Tiller, Koren, and Cook's (2002) observation of the specific electroencephalographic signatures over the occipital regions of Mr. Swann while he engaged in remote viewing. Increases in the proportion of activity within the borderline between alpha and theta activity, often described as alphoid activity, has been associated with rich subjective imagery such as the sense of bilocation when the sense of self is perceived to be detached from the body (Tart, 1968). If an increase in power within the theta bands of a person can be facilitated by the types of activity induced within the brains of the stimulus person by our experimental treatment, then experiences of "bilocation" and subjective imagery might be induced by other people distant to a person through as yet unspecified natural processes.

The significant interaction between lobe, hemisphere, and phase, and whether the person served as the response person before or after they had received the magnetic field stimulation for power within the 6.0-Hz to 6.9-Hz band support the hypothesis that the parieto-occipital region of the right hemisphere (Roll, Persinger, Webster, Tiller, & Cook, 2002) or the occipital lobe of the right hemisphere may be involved with the processes attributed to paranormal phenomena (Persinger & Lalonde, 2000). Persinger and Lalonde (2002) reported that exposure to novel complex visual stimuli, such as the Kimura figures, is first associated with increased activity in the right occipital region. Subsequent exposures show a marked habituation in the right hemispheric response but a compensatory increase in activity within the left occipital region.

In the present study, 2.5 min. had elapsed by the time we sampled the brain activity. This may have been sufficient time for the neurons within the right occipital region to have decreased their synchronized activity because the stimulus was no longer "novel." This pattern was only observed for the subjects who had not been exposed to the magnetic fields previously. When the subjects who had been first exposed to the magnetic fields served as response persons, neither the frontal nor the occipital lobes displayed an increase in power during the presentation of the 100-msec. fields with 20-msec. rates of change. However, they did show an increase in power over the left parietal and right temporal lobes when the stimulus person was exposed to the fields whose duration at the solenoids was 20 msec. with an acceleration of 2 msec. The significance of this observation remains to be explained.

Although the distance between the stimulus person and the response person in this study was not systematically varied, one would predict these specific amplifications in theta activity over the brains of the response persons should occur at substantial distances. If this statement is verified by experimentation, then the innovative concepts of Puthoff and Targ's "perceptual channel" (1976) for the sharing of information over kilometre distances could be tested within the laboratory.

A significant component of the theta band is generated by aggregates of neurons within the hippocampal formation. Considering its role in detection of novel stimuli, representation of spatial relationships, and the preservation of the code of sensory information (Vinogradova, 1975), this limbic component could be a candidate to mediate this information. It could be consolidated with the ongoing representations produced by normal sensory transformations and later be reconstructed as "memories" (Persinger, 1985). The contemporary technical sophistication for both quantitative electroencephalography and the application of complex magnetic fields would allow precise quantitative predictions.

There were other statistically significant effects within the other bands measured in this study. The criterion for statistical significance was set at $p < .05$ and $p < .01$. With 144 effects (Table 2), one would expect about 7 and 1, respectively, of these effects to be significant by chance alone. If even some of these statistically significant effects are not spurious, then the analyses suggest that the effect of exposing one person to a complex magnetic field may be associated with a number of complex changes within the electroencephalographic activity of the response person. It may be found that, like observing the "peaks" of signals during mass spectrometry, that different external stimuli may be reflected in a "profile" of increases in power within specific frequency bands, hemispheres, and lobes.

When we first recorded the usual experiences reported by people exposed to the circumcerebral magnetic fields and how these experiences seem

to be congruent with the reported experiences of emotionally significant people at a distance, the first consideration was application to marital counselling (Persinger, 2003). It was reasoned that if emotional congruity could be encouraged between two people who would not interact verbally, then experimental enhancement of the essential processes of primate bonding might facilitate reconciliation. The authors had noticed that couples with whom emotional congruity appeared more prominent during the experiments also reported reinforcement histories of disproportionately more episodes of phenomena they attributed to "being aware of the other's thoughts without talking." This hypothesis must still be tested.

If these results from the present study are valid and can be generalized, then there may also be an experimental method to study the effects of prayer, meditation, and altered states upon others within the laboratory. From a behavioral perspective, meditation and prayer are simply altered states of brain activity, and the participants in these activities are simply stimuli. When groups of people are in close proximity displaying these behaviours, beat frequencies and interference patterns might emerge within the shared space that could simulate the complexity of the electromagnetic configurations generated in the present experiment.

An external cohesive factor, perhaps a particular frequency and intensity of geomagnetic activity within which all of the participants are exposed, could facilitate this process (Persinger, 1983). The authors also predict that different spaces within which the aggregates of people are clustered could determine the beat frequencies and patterns of interference. Given the capacitance of about 9 picoFarads/m (permittivity) and the inductance of about 1 microHenry/m (permeability) of free space and the formula for resonant frequency equal to $1/(2\pi \cdot (\text{square root of the product of henrys} \cdot d \text{ and capacitance} \cdot d$, where d = distance in meters), the actual length of the real space in which the people are aggregated would affect the optimal resonant frequency. With distances of 10 m to 100 m, the resonant frequency would be within the MHz range.

The authors suggest this facilitation might, as indicated by the present results, affect the brains of people who are proximal to others who are concentrating upon them. They would be unaware of this influence. It may be relevant that the major spectral power of frequencies associated with hippocampal activity occur between 5 and 7 Hz and 40 to 50 Hz. Direct input into the hypothalamus from the hippocampal-amygdaloidal complex can affect the release of powerful neuropeptides such as adrenocorticotrophic hormones (Bohus, 1975).

An elevation of the power within a theta band may not reflect the content of the change any more than the increase in intensity of geomagnetic activity indicates the intricacies of the frequencies or the loudness of a ra-

dio's speaker provides the information within the commentary. The authors suspect that enhanced theta measured from millions of neurons within the cerebral cortices would be associated with the complex sequences from contributing neurons that actually control the viability and stability of the immune system. For example, shifts in the frequency of neuronal firing within the ventromedial hypothalamus (after modulation by input from the hippocampal-amygdaloid complex) accompany and may influence the immune response (Besedovsky, del Rey, & Sorkin, 1985).

Because the functions of all organs of the body are either controlled directly or are strongly modulated by the brain, the appropriate stimulation of regions of the brain might affect the person's health. Activation of these regions might be reflected by greater power within the 5-Hz to 7-Hz range of electroencephalographic activity. The results of this study indicate that cognitive focus upon another person, during exposure to complex magnetic fields, might affect his brain activity and potentially his health. Historical attributions of such changes in vitality to interventions from a nonphysical, invisible deity would not be required.

The second implication for the results of this study involves large groups of people. One phenomenon that must still be explained is the apparent exponential expansion of religious or political conversions that permeate large aggregates of people who are contained within a small area. Terms such as "social facilitation" are labels that do not reflect a mechanism. Experiences during these brief but powerful episodes appear to modify the person's beliefs for a lifetime.

The emotional nature of these beliefs as well as their permanent memory might reflect the prominent functions of the limbic system. If enhancement of electroencephalographic activity within the bands noted in the present study can be simulated by tens of thousands of people focusing upon the same stimulus, then the "nonlocality" of emotionally laden beliefs within the crowd might occur.

The mechanism by which the representation of the changes applied to the stimulus persons' brains occurred as shifts in electroencephalographic power within the brains of the response persons must still be established. The authors have carefully avoided the terms "induction," "transmission," or their variants that apply to the classical mechanics of electromagnetic fields. The authors predict the physical mechanisms may involve the temporal components of electromagnetism and gravity within which both the stimulus and response persons were immersed. That each person served as a stimulus person and as a response person, separated by a time interval of one week, allows the possibility of the type of temporal entanglement between two objects as suggested by both chaos theory and Quantum Mechanics (Einstein, Poldolsky, & Rosen, 1935; Cramer, 1997). However, because

the pairs of people were siblings, entanglement may have existed before the experiment began.

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